Time- and angle-resolved photoelectron spectroscopy of the three-dimensional Dirac semimetal Cd_3As_2

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Dirac semimetals exhibit a characteristic linear band dispersion in the vicinity of discrete points in momentum space where valence and conduction bands touch. The most prominent examples are two-dimensional Dirac cones in graphene [1] and at the surfaces of topological insulators [2]. However, cone-shaped band dispersions were proposed to exist also in three dimensions [3]. A material that was not only theoretically predicted but also experimentally verified to host a pair of 3D Dirac cones is Cd_3As_2 [4-7]. The band crossings are protected by time-reversal and inversion symmetry. By breaking these symmetries, the material can be driven into other topological phases such as a Weyl semimetal and a topological insulator state [4].

Here, we present first results of a time- and angle-resolved photoemission study of the (112) surface of Cd_3As_2. While the band dispersion of the Dirac cone has already been subject of several studies [5-7] only little is known about the ultrafast dynamics of the material from transient optical spectroscopy measurements [8-10]. Our technique enables us to get the first momentum-resolved insights into the dynamics in the vicinity of the 3D Dirac cone initiated by the absorption of 800nm pump pulses. The results are discussed under consideration of recent studies of Cd_3As_2 and in comparison to ultrafast dynamics observed in related materials.

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